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ABSTRACT

Studies on the acquisition of relative clauses are reviewed. Two polarities among a variety of possible approaches are: Slobin's (1971) study that emphasizes acquisition process and learning strategies, and studies like Sheldon's (1974) that emphasize the linguistic structures involved. Early proposals that children experience more difficulty in processing discontinuous, as distinct from contiguous elements, have been contradicted by the parallel function hypothesis. More recent studies tend to emphasize an examination of the processing heuristics used by children, and they show that at times children have no adequate processing strategies. Most studies of relative clause acquisition report on experiments in which children were instructed to act out the content of sentences containing relative clauses by manipulating toy animals. By observing children's responses over the course of many experiments, investigators have been able to systematize children's responses into a number code of response types, which can be classified into a particular sentence type. All of the reviewed studies have in common that they suggest new avenues of approach to an understanding of children's acquisition of relative clauses. (SW)

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THE RELATIVE CLAUSE IN CHILD LANGUAGE: A Review.

John Blake More

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In 1971 Dan Slobin proposed that center embedded relative clauses should be more difficult for children than right-branching relative clauses, and in support of this proposal he points to data from many studies of child language which show that children do, in fact, have more trouble repeating center embedded than right-branching relative clauses. This difference is explained by the increase in memory load placed on the child by the interruption of the main clause. On the other hand, Sheldon (1974) set up a hierarchy of sentence types from easiest to most difficult based on the relationship holding between the coreferential NP and the other sentence elements in both of the clauses in which it appears. According to Sheldon's parallel function hypothesis, a sentence will be easier if the coreferential NP is either the subject or object of both clauses.

These studies represent two polarities among a variety of possible approaches and combinations of approaches in the study of relative clause acquisition: Slobin's study places emphasis on the acquisition process and on learning strategies, while studies like Sheldon's emphasize more the linguistic structures involved. Specifically, in Sheldon's study, the grammatical function of the relativized NP's is taken as a more likely indicator of the relative ease with which a child will master a given sentence than the strategies with which he presumably processes surface strings.

Most, but not all studies of relative clause acquisition report on experiments in which children were instructed to act out the content of sentences containing relative clauses by manipulating toy animals. By observing children's responses over the course of many experiments, investigators have been able to systematize children's responses into a number code of response types. Only specified response types will be appropriate for a particular sentence type. The classification of a response type is determined by the order in which nouns and verbs appear in a sentence:

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(1)          (1)          (2)
The horse kicked the cow that pushed the pig.
     (1)          (2)          (3)
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Sentence types are coded according to the grammatical function of the coreferential NP's in the clauses in which they appear, as follows:

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(2) OO (object in both clauses)
SS (subject in both clauses)
SO (subject in main clause; object in relative clause)
OS (object in main clause; subject in relative clause)

In sentence (1) the verbs are numbered above and the nouns below. The code for a response type will contain two numerals followed by a comma followed by two more numerals, as follows:

(3) 12, 23

The response type coded in (3) is to be read so that the numerals to the left of the comma give the subject-object relation for the first verb in the sentence, and the numerals to the right of the comma give the subject-object relations for the second verb in the sentence. So, a child who gives (3) as a response to (1) has the horse (N1) kick (V1) the cow and the cow push the pig. His response is an accurate reflection of the grammatical and semantic relations expressed in (1) and it is therefore correct: a 12, 23 response is appropriate to an O,S sentence like (1).

Slobin's (1971) proposal that right-branching relative clauses should be easier for a child than center embedded clauses follows from his UNIVERSAL D4: "The greater the separation between related parts of a sentence, the greater the tendency that the sentence will not be processed." This "universal" formalizes the child's tendency to interpret contiguous elements within a string to be more closely related grammatically and semantically than non-contiguous elements.

The NVN strategy, proposed by Bever (1970), predicts that any sequence of noun-verb-noun corresponding to subject-verb-object will be easier to process than the same sequence when it corresponds to other grammatical relations. Under an analysis that incorporates this strategy, one would expect that sentences (5) and (6) are easier than (4) and (7) on the basis of the fact that in (5) and (6) the main clause is not interrupted and can therefore be processed by the NVN strategy. Also, under this kind of analysis, sentence (7) should be especially difficult since it contains a VV sequence with little indication of the roles of the associated nouns.

(4) The cow who pushed the horse licked the goat. (S,S)
N V N V N

(5) The cow pushed the horse who licked the goat. (O,S)
N V N V N

(6) The cow pushed the horse who the goat licked. (O,O)
N V N N V

(7) The cow who the goat kicked hit the dog. (S,O)
N N V V N

Further, the minimal distance principle (MDP), first developed in Rosenbaum (1965, 1967), and introduced into the study of child language by C. Chomsky (1969) in her studies of complement verbs, has come to figure prominently in the study of relative clause acquisition. According to the MDP, as originally developed, the subject of a complement verb (a verb with to) is the NP most immediately preceding it. However, the relevance of the MDP to relative clause acquisition has been questioned by at least one investigator (see below and de Villiers et al., 1976).

Sheldon (1974) objects to Slobin's claim on the grounds that his evidence consists exclusively of production data, which she says is "not a reliable indication of the way a sentence is understood" (p. 2). She reports on an experiment in which children were given relative clause sentences and required to act them out with toy animals. She reports that her results disconfirm Slobin's prediction and that they support her own PARALLEL FUNCTION HYPOTHESIS, which she states as follows:

> In a complex sentence, if coreferential NP's have the same grammatical function in their respective clauses, then that sentence will be easier to process than one in which the co-referential NP's have different grammatical functions. The grammatical function of the relative pronoun will be interpreted to be the same as the antecedent.

Sheldon's children were divided into three age groups. Within each age group the number of correct answers was significantly greater for the parallel function sentences (SS, OO) than for the other sentence types. Her totals for all age groups combined (with 99 total response scores for each sentence type) are as follows: SS: 52; SO: 17; OS: 29; OO: 50. In an attempt to explain some of the incorrect answers in her data, Sheldon introduces the notion of extraposition. She discovered that in interpreting object relatives (OO and OS) many children understood the relative clause as modifying the subject of the sentence. For example, in the OS sentence (8):

(8) The pig bumps into the horse that jumps over the giraffe.
1 2 3

44% of the children gave an incorrect 12,13 response, which Sheldon takes as clear disconfirmation of Slobin's OPERATING PRINCIPLE D because these children are using an extraposition strategy in their interpretation of sentences like (8). Under this analysis, extraposition and parallel function are related as follows: "In attempting to find the antecedent to the relative pronoun in object relatives, children over-relied on the extraposition interpretation. In attempting to assign a function to the relativized NP they over-relied on the parallel function interpretation" (p. 12). Sheldon concludes that her findings clearly support the parallel function hypothesis, that OO and SS sentences should

be easier for children, and that the incorrect responses in her data can be traced to overextensions of both the parallel function analysis and extraposition. In her final remarks, she says that "one fruitful avenue for future research would be an investigation of the role that the Parallel Function Hypothesis has in the acquisition of other languages" (p.13). As we will see below, the results of at least one study, of Japanese, definitely do not bear out the expectations of the parallel function hypothesis.

Subsequent to Sheldon's study, most investigators have expressed dissatisfaction with the analysis based on parallel function, principally because of its over-emphasis on opaque grammatical relations and its disregard of important surface features, like word order. Michael Smith (1974) reports on a study that gives very different results from those elaborated by Sheldon. Smith used nonsense words in an elicited imitation task. His results show that, contrary to the predictions of the parallel function hypothesis, OS sentences are the easiest of all sentence types, followed by SS, OO, and SO in increasing order of difficulty. He explains his results by means of (1) embeddedness, (2) the NVN strategy, and (3) the minimal distance principle.

In an attempt to test the differing results obtained by Sheldon and by Smith, de Villiers et. al. (1976) introduced an additional complication into the study of relative clauses by including among their test items some act-out directives containing indirect objects. The introduction of indirect objects increases the number of sentence types to nine, rather than the four used by Sheldon and Smith, and the verbs used in the de Villiers study were limited to shouted to, spoke to, whispered to, and yelled to, in order to avoid further complications involved with verbs like give, which take direct as well as indirect objects. Table 4 from this study is given as (9) and it shows the percentage of children who gave each response type for each sentence type (the correct responses are starred).

(9)

Sentence	1-2	1-3	2-1	2-3	3-1	3-2
SS	75*	46*	7	32	6	12
SO	29	33*	44*	46	5	3
SI	16	37*	25*	36	10	4
OS	75*	36	6	39*	6	11
OO	74*	8	8	10	28	43*
OI	75*	3	7	4	19	35*
IS	62*	25	7	47*	66	5
IO	61*	14	4	14	18	45*
II	68*	10	6	9	12	39*

The error analysis is by far the most important -- and most innovative, section of the de Villiers paper. Since 75% of their children responded correctly to the first actout response for sentence types SS, OS, and OI, the authors state that their results definitely disconfirm the parallel function hypothesis, and so they definitely favor a processing heuristics approach such as that followed by Smith (1974), and their order of accessibility is given in (10) along with Sheldon's and Smith's for ease of reference:

(10) de Villiers et al.: (OS, SS) (OO, IS, OI) (IO, II) (SO, SI)
Sheldon: (SS, OO) (OS, SO)
Smith: OS, SS, OO, SO

However, the fact that such a high percentage of their subjects did so well on the first NVN sequence of each sentence leads these authors to disregard right branchingness as a major processing strategy. They propose that the child initiates his analytic procedure to the left, that is, with the first NVN sequence, and then on the basis of what is left (NV, VN) conducts a kind of search for either a subject or object in order to complete the remaining grammatical relations. The reason their children did so poorly on SO and SI sentences is that these do not have an initial NVN sequence, and in addition, they have what the authors call a "deceptive" NVN sequence (NVVN). De Villiers et al. dismiss Smith's invocation of the minimal distance principle entirely, claiming that ". . . it reduces to a more limited version of the NVN strategy" (p. 24) . . . and ". . . we do not need to invoke a special minimal distance principle, with its own theoretical and empirical history, to account for the present results or those of Smith."

There is evidence from Japanese which disconfirms the PARALLEL FUNCTION HYPOTHESIS and supports the processing heuristics approach. Kenju Hakuta (1976) reports on an act-out experiment on relative clause comprehension. Before going into the details of that experiment and its results, we examine several complications introduced by the structure of the Japanese language: the following paragraph is a close paraphrase of Hakuta (pp. 10-11).

Both SOV and OSV are possible word orders in Japanese. In the case of SOV-ordered sentences, SS sentences are left-branching, and OS sentences are center-embedded. On the other hand, for the OSV order, SS sentences are center-branching and OS sentences are left-branching. This is different from, and more complicated than, the situation in English, where embeddedness is always correlated to the case role of the complex NP. Thus in Japanese the relative clause sentence is expounded by eight different types: the four dealt with extensively in English times (SOV, OSV).

Hakuta found in preliminary testing that older Japanese children experienced an unusual amount of difficulty on these eight sentence types, so in order to simplify the task, he introduced intransitive verbs into some of his test items, with the result that only six of the eight possible sentence types were represented. These sentences are given in Hakuta's Table 3, and are reproduced here as (11):

(11) (1) SS SOV [LAUGHED ELEPHANT]-ga FROG-o KICKED.
(2) SS OSV FROG-o [LAUGHED ELEPHANT]-ga KICKED.
The elephant that laughed kicked the frog.
(3) OS SOV ELEPHANT-ga [LAUGHED FROG]-o KICKED.
(4) OS OSV [LAUGHED FROG]-o ELEPHANT-ga KICKED.
The elephant kicked the frog that laughed.

(11) (Continued)
(5) SS (OSV) [ELEPHANT-o KICKED FROG] -ga LAUGHED.
The frog that kicked the elephant laughed.
(6) SO (SVO) [ELEPHANT-ga KICKED FROG] -ga LAUGHED.
The frog that the elephant kicked laughed.

Hakuta found that "for SS. . . SOV is easier for the children" (p. 12) but that for OS, OSV is easier. He attributes the difference to the fact that SS/SOV and OS/OSV are left-branching, but SS/OSV and OS/SOV are center embedded (p. 12). In addition to the word-order complexities pointed out here, there are further complications in Japanese related to the use of case marking particles (-ga = subject; -o = object). Hakuta proposes a strategy hierarchy based on the interaction of word order and case marking. Major strategies are related to order, and strategies further down in the hierarchy come into play when order strategies turn out not to function, (e.g., when a verb appears sentence initially). The important point is that Hakuta (1976) clearly disconfirms the parallel function hypothesis: "When SS and SO sentences are compared . . . children perform better on SO than on SS. This is clearly against the parallel function hypothesis, which would predict SS to be easier" (p.13).

Tavakolian (1977) reports that in her study, 12, 13 was the predominate response type for SS and OS sentences, and that for the other sentence types, it was a common response. On the basis of this fact, she hypothesizes that in processing relative clauses, children rely most heavily on a conjoined clause analysis. The linear arrangement of SS and SO types (ignoring the presence of the relative pronouns) is identical to the arrangements of conjoined sentences.

(12) N that V N V N (SS)
N V N and V N (Conjoined)
The cow (that) hit the horse pushed the goat.
The cow hit the horse and pushed the goat.

N V N that VN
N V N and NV
The horse licked the goat who pushed the cow. (OS)
The horse licked the goat and pushed the cow. (conjoined)

Tavakolian sets up a hierarchy of relative clause sentences as follows:

SS
OS
SO
OO

This hierarchy differs from those suggested by previous investigators principally in that it is not designed to show ease of processing. Rather, it is a description over time of the learning process. Initially, the conjoined sentence analysis is applied to all sentence types in the

list, with appropriate results only in the case of those sentences (SS) whose surface structures correspond to conjoined sentences. As he matures, the child begins to eliminate sentences from the hierarchy, starting with those (OO) that most widely diverge from the form of a conjunct, so that at any given point in his development, if the child applies the conjoined sentence analysis to a particular sentence, he also applies that analysis to the sentences above it in the hierarchy. "The conjoined clause analysis required either an expressed or a missing subject in the second clause" (p. 38). "Unlike the situation with OS relatives where the conjoined-clause analysis easily generalized to them, children have no general strategy which could apply to OO relatives to specify the referent of the missing object" (p. 39).

It will be recalled that Sheldon (1974) attempted to explain some of the errors in her data by suggesting that children overgeneralize an extraposition strategy, especially in the case of OO sentences. Tavakolian objects to this suggestion on two counts. In the first place, she points out, "because a child knows that some relative clauses modify the matrix object, he does not overgeneralize that all of them modify the matrix object" (p. 40). And secondly, she says that ". . . we would expect children who incorrectly comprehend OO relatives because of extraposition to get SO relatives correct" (p. 40), and this is of course not the case.

It is to be noted that Tavakolian's hierarchy is not based on the number of correct responses given in testing, as were those offered by previous investigators. A hierarchy of sentences that is based on the number of correct answers in her data is given in (13) as Tavakolian, C. Tavakolian S (strategy) refers to the order (right-to-left) in which children abandon the conjoined-clause strategy in their attempts to process relative clause sentences.

(13) Hierarchies of accessibility according to various investigators. (Left-hand side is easiest.)

Sheldon (1974)		(SS-OO) (OS-SO)
Smith (1975)		OS-SS-OO-SO
de Villiers (1976)		(OS-SS) (OO-IS-OI) (IO-II) (SO-SI)
Tavakolian (1977)	S	SS-OS-SO-OO
	$\overline{C}$	SS-OO-SO-OS (p.46)

Notice the close resemblance between Tavakolian's $\overline{C}$ and Sheldon's order. In this connection, Tavakolian offers a bit of insightful reasoning:

> By arranging children's responses in terms of exclusion from the conjoined-clause analysis, we can see which relative clauses are excluded first and examine their characteristics. It is worth noting that the order of relative clauses established in this way is different from the order which results if the relative clauses are ordered according to the number of correct responses. The latter order, from

> most correct to least correct, is SS, OO, SO and OS. The relative clause which receives the fewest correct responses is the last to be excluded from the conjoined clause analysis. The hierarchy established in (13) reflects the ease of imposing an interpretation on sentences containing various relative clause types and does not correspond to the number of correct responses.

The main approach here is by way of the preponderance of response types: since the I2, I3 type is the one that predominates in relation to SS and OS sentences, and since these sentences are the ones whose linear surface order most closely resembles that of conjoined structures, it is reasonable to suspect that children may process these sentences as if they were conjoined structures. Throughout her discussion Tavakolian stresses her position that children interpret SS sentences correctly not because they can generate them spontaneously (that is, not because they are part of the child's grammar) but because the SS surface form happens to be identical to the form of a conjoined clause sentence (which has a missing subject in the second conjunct, and which is part of the child's grammar), and it is therefore easy for the child to use this analysis. It is worth pointing out that the conjoined-clause hypothesis is similar to the approach taken by de Villiers et al. in that it sees the child as beginning his analysis to the left and proceeding to the right. But some important differences will be pointed out below.

Along with the conjoined clause analysis, Tavakolian suggests that children use lexical information in processing relative clause sentences. She specifies this as a companion hypothesis to the combined-clause analysis (p. 3):

> Hypothesis B: Where the correlation of thematic relations and subcategorization features of a verb occurring in a surface string differs from the correlation of thematic relations and subcategorization features of the verb in deep structure, then children will attempt the most direct projection of thematic relations onto the surface string when the verb occurs in a complicated sentence whose structure they are uncertain of.

In the case of sentence types SS and OS, the child's reliance on Hypothesis B is clearly greater than it is with OO or SO. As Tavakolian points out, "The conjoined-clause analysis requires either an expressed or a missing subject in the second clause" (p. 38). Since OO sentences do not meet this requirement, they are the first ones for which the child abandons the conjoined clause analysis. But the child has no functional strategy for applying lexical information, so he is in the position of guessing which of the two NP's in the first clause is the referent of the second. This accounts for the "vacillation between I2, 31 and I2, 32 responses by individual children" (p. 43). This suggestion

that at certain points in their analyses children simply do not have adequate strategies to deal with some surface structures and are reduced to guessing is of great interest to our understanding of language acquisition and it jibes well with Tavakolian's very careful analysis of the errors in her data.

The SO sentence type is subject to insightful analysis in Tavakolian's discussion. With two nouns preceding the first verb, it is the one children found the most difficult to comprehend in terms of concentration and spread of response types. Two productive strategies come into conflict when the child tries to determine the subject of the first verb:

a) The first NP of the sentence is the subject.
b) The NP preceding the verb is the NP.

The child has no device for resolving this conflict, and this lack is reflected in the inconsistency of the responses in the data. Here again the child is guessing. Tavakolian's concluding observations (p. 50) are instructive:

> There was a much greater variety of responses to OO and SO relatives, which do not conform to the order in conjoined clauses, than to SS and OS relatives, which do conform. This difference in the relative difficulty of assigning a consistent interpretation to a string is due to the lack of direct correspondence between the correlation of thematic relations and sub-categorization features in the lexical entry and the correlation of thematic relations and the order of NP's in the surface structure.

Direct comparison of the conclusions reached by de Villiers (1976) and by Tavakolian (1977) is difficult, in the first place because of the very different results they obtained on OS sentences. De Villers et al. found them among the most correctly responded to, while for Tavakolian they are the ones with which her subjects had the most difficulty. Further, the two sets of conclusions are based on differing assumptions about the child's processing abilities in relation to the flow of language. Pointing to their subject's "remarkably high " (p. 18) performance on initial NVN sequences, de Villiers et al. proposes that processing is a left-to-right enterprise: the child interprets the first NVN sequence and then uses additional strategies to deal with the remainder of the sentence. In support of this "segmenting," they refer to the "widespread utility of the NVN strategy in dealing with simple active declarative sentences and (to) its overextension by children to passive constructions" (p. 23). On the other hand, Tavakolian sees children as attempting to impose the conjoined clause analysis on the entire sentence. Her argument is based on the general pervasiveness of the I2, I3 response type: It is "the only response consistently used on all four types of relative clauses" (p. I2). She cites studies which show

that conjunction of elements with and, including clausal conjunction, occurs very early in spontaneous speech.

Recently, an attempt has been made by Solan and Roeper (1977) to show that neither the parallel function hypothesis (Sheldon) nor the structural misrepresentation hypothesis (Tavakolian) can account exclusively for the errors children make in relative clause interpretation, but that, taken together, these two approaches do satisfactorily explain the kinds of errors children make. The investigators conducted an experiment which was "intended to separate errors according to whether they are caused by the child's misunderstanding of the syntactic structure, or the grammatical relations within the sentence" (p. 6). The principal way in which this study differs from previous ones is that it looks at children's knowledge of verbal subcategorization features other than [+ _____ NP]; specifically, it contrasts this feature with [+ _____ NP, PP] (both are transitives). The verbs used by the investigators were push and put. Errors were separated into two classes, functional and structural. An error is designated structural when a child either a) interprets the relative clause as modifying the subject instead of the object,or b) fails to attach the relative clause at all (has to ask "Who did what?"). ". . . whether or not a child will commit either of these errors depends crucially on whether or not the main verb is push or put" . . . "whether or not a child makes one of these structural mistakes has nothing to do with whether the sentence is an OS or an OO sentence" (p.11). Additionally there are functional errors and these are unrelated to whether the main verb is push or put, but rather, ". . . involve misinterpreting the roles of the NP's within the relative clause, regardless of which NP the relative clause is interpreted as modifying" (p. 13). The investigators' summary comments are instructive:

> We can see from the above data that the types of structural errors that children make in their interpretation of relative clauses are not specific to this aspect of their grammars. Instead, they follow directly from the much more general notion of children positing syntactic structures at early stages which have relatively little embedding. As their linguistic development progresses, they learn to embed clauses and other material more deeply. This developmental sequence itself may follow from the fact that embedded structures are more difficult to understand than conjoined ones (see, e.g. Chomsky and Miller, 1963). But the point to be made here is that structural, as well as functional strategies and generalizations play a substantial role in the child's acquisition of syntax.

Available studies on the acquisition of relative clauses offer a variety of conflicting and frequently confusing information. Early proposals that children experience more difficulty in processing discontinuous, as distinct from contiguous elements, have been contradicted by the parallel function hypothesis. More recent studies tend to

emphasize an examination of the processing heuristics used by children, and they show that at times children have no adequate processing strategies. All of the studies reviewed here have in common the virtue of suggesting new avenues of approach to an understanding of children's acquisition of relative clauses, and there is no sign that students of child language intend to leave any of these avenues unexplored. With one exception, the investigations reviewed here have dealt with English. Hopefully, we will soon see more data and more analyses from other languages.

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